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**Graphite nanofibers for electron emitting source and cathode of lithium ion secondary battery comprises graphene sheets having truncated conical shape, sequentially arranged through catalytic metal particles**

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US 20020009637	A1	20020124	US 2001775497	A	20010205	200210
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Abstract (Basic): EP 1122344 A2

**NOVELTY** - A graphite nanofiber having cylindrical structure comprises graphene sheets (12), each having truncated conical shape, arranged sequentially through catalytic metal particles. Alternatively, small pieces of graphene sheets having a shape adapted for a surface shape of catalytic metal particle, are arranged one over the other in layers, through catalytic metal particles.

**DETAILED DESCRIPTION** - INDEPENDENT CLAIMS are also included for:

(1) an electron emitting source which has carbon layer comprising graphite nanofibers, deposited on electrode substrate (11) or its patterned surface;

(2) preparation of electron emitting source which involves growing a graphene sheet on an electrode substrate or its patterned surface comprising iron, cobalt or their alloy, using carbon containing gas and hydrogen gas, by thermal CVD method, or the method involves dispersing graphite nanofiber powder in a solvent to form a paste and applying the paste on a electrode substrate or immersing electrode substrate into a dispersion of graphite nanofiber powder in solvent and depositing graphite nanofibers on the substrate by electro-deposition;

(3) a display element having several transparent conductive films with desired pattern, an electron emitting source and a luminous body opposed to carbon layer, and designed so that if selecting the carbon layer and the transparent conductive film and applying electric voltage, electrons are emitted from the carbon layers, so that only a specific portions on luminous body emit light;

(4) a negative electrode carbonaceous material comprising graphite nanofibers; and

(5) a lithium ion secondary battery which has anode including lithium transition metal oxide as anode active material, cathode including carbonaceous material comprising graphite nanofibers as cathode active material and organic solvent-based electrolyte.

**USE** - For electron emitting source and cathode material of lithium ion secondary battery (all claimed).

**ADVANTAGE** - The graphite nanofibers have excellent electron

emission characteristics such as high electron emission density and electron emitting ability at low electrical field and high quality as active material for cathodes. The nanofiber provides excellent charging and discharging capacities, to cathode and long life cycle, fast charging ability and high service or discharge capacity, to batteries.

DESCRIPTION OF DRAWING(S) - The figure shows sectional view structure of graphite nanofibers.

Electrode substrate (11)

Graphene sheet (12)

Through-hole (13)

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Title Terms: GRAPHITE; ELECTRON; EMIT; SOURCE; CATHODE; LITHIUM; ION; SECONDARY; BATTERY; COMPRISE; SHEET; TRUNCATE; CONICAL; SHAPE; SEQUENCE; ARRANGE; THROUGH; CATALYST; METAL; PARTICLE

Derwent Class: E36; F01; L03; V05; X16

International Patent Class (Main): D01F-009/127; H01J-001/30; H01M-004/60

International Patent Class (Additional): C01B-031/02; C23C-016/26;

H01J-001/304; H01J-009/02; H01J-029/04; H01J-031/12; H01M-004/02;

H01M-004/58; H01M-010/40

File Segment: CPI; EPI

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DIALOG(R) File 347:JAPIO

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GRAPHITE NANOFIBER, ELECTRON EMITTING SOURCE AND METHOD FOR PRODUCING THE SAME, DISPLAY ELEMENT HAVING THE ELECTRON EMITTING SOURCE, AND LITHIUM ION SECONDARY BATTERY

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#### ABSTRACT

PROBLEM TO BE SOLVED: To provide a cathode material capable of achieving a high electron-emitting density and an electron-emitting properties in a low electric field, and further to provide an electron-emitting source having the material, a method for producing the electron-emitting source, a display element having the electron-emitting source and a lithium ion secondary battery obtained by using the carbonaceous material as an activate material for a cathode.

SOLUTION: This graphite nanofiber material has a columnar structure obtained by laminating graphene sheets having truncated ice cream cone shapes through a catalytic metal, or a structure obtained by stacking small fragments of the graphene sheets having shapes along the surface shape of the catalytic metal through the catalytic metal. The catalytic metal is composed of Fe, Co or an alloy containing at least one kind of these metals. The electron-emitting source, the display element constituted so that a desired part of a light emitter may emit the light, the carbonaceous material for the cathode of the battery, and the lithium ion secondary battery are obtained by utilizing the material.